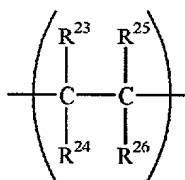


Claims

- [c1] 1.A curable composition, comprising:
a functionalized poly(arylene ether);
an alkenyl aromatic monomer;
an acryloyl monomer; and
a polymeric additive having a glass transition temperature less than or equal to 100 ° C and a Young's modulus less than or equal to 1000 megapascals at 25 ° C;
wherein the polymeric additive is soluble in the combined functionalized poly(arylene ether), alkenyl aromatic monomer, and acryloyl monomer at a temperature less than or equal to 50 ° C.
- [c2] 2.The curable composition of Claim 1, wherein the polymeric additive is soluble in the combined functionalized poly(arylene ether), alkenyl aromatic monomer, and acryloyl monomer at a temperature less than or equal to 30 ° C.
- [c3] 3.The curable composition of Claim 1, wherein the polymeric additive has a glass transition temperature less than or equal to 25 ° C.
- [c4] 4.The curable composition of Claim 1, wherein the polymeric additive has a Young's modulus less than or equal to 100 megapascals at 25 ° C.
- [c5] 5.The curable composition of Claim 1, wherein the polymeric additive is selected from the group consisting of poly(alkenyl hydrocarbon)s, poly(alkyl (meth)acrylate)s, poly(vinyl ester)s, polysiloxanes, and combinations comprising at least one of the foregoing polymeric additives.
- [c6] 6.The curable composition of Claim 1, wherein the polymeric additive comprises a poly(alkenyl hydrocarbon).
- [c7] 7.The composition of Claim 6, wherein the poly(alkenyl hydrocarbon) comprises at least about 80 weight percent of repeating structural units having the formula



wherein R^{23} – R^{26} are each independently hydrogen, C_1 – C_{12} alkyl, C_2 – C_{12} alkenyl, C_6 – C_{18} aryl, C_7 – C_{18} aralkyl, or C_7 – C_{18} alkylaryl.

[c8]

8.The composition of Claim 7, wherein R^{23} – R^{26} are each independently hydrogen, C_1 – C_{12} alkyl, or C_2 – C_{12} alkenyl.

[c9]

9.The composition of Claim 6, wherein the poly(alkenyl hydrocarbon) is selected from the group consisting of polybutadiene; polyethylene; polypropylene; polybutene; poly(4-methyl-1-pentene); a block copolymer comprising a first block that is the polymerization product of styrene and/or alpha-methyl styrene and a second block that is the hydrogenated polymerization product of butadiene and/or isoprene; and combinations comprising at least one of the foregoing polyolefins.

[c10]

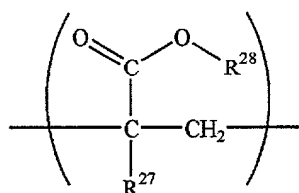
10.The composition of Claim 6, wherein the poly(alkenyl hydrocarbon) is selected from the group consisting of polyethylenes, polypropylenes, poly(4-methyl-1-pentene)s, polybutadienes, carboxy-terminated butadienes, carboxy-terminated butadieneacrylonitrile copolymers, polyisobutenes, polyisoprenes, ethylene-propylene copolymers, ethylene-propylene-diene terpolymers, styrene-butadiene copolymers, styrene-isoprene copolymers, isobutylene-isoprene copolymers, butadiene-isoprene copolymers, and combinations comprising at least one of the foregoing polyolefins.

[c11]

11.The curable composition of Claim 1, wherein the polymeric additive comprises a poly(alkyl (meth)acrylate).

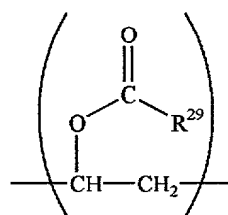
[c12]

12.The composition of Claim 11, wherein the poly(alkyl (meth)acrylate) comprises at least 80 weight percent of repeating structural units having the formula



wherein each R^{27} is independently hydrogen or methyl, and each R^{28} is independently C_1-C_{12} alkyl.

- [c13] 13.The composition of Claim 12, wherein R^{28} is C_1-C_6 alkyl.
- [c14] 14.The composition of Claim 11, wherein the poly(alkyl (meth)acrylate) is selected from the group consisting of poly(butyl acrylate), poly(2-hexyl acrylate), and combinations comprising at least one of the foregoing poly(alkyl (meth)acrylate)s.
- [c15] 15.The curable composition of Claim 1, wherein the polymeric additive comprises a poly(vinyl ester).
- [c16] 16.The composition of Claim 15, wherein the poly(vinyl ester) comprises at least 80 weight percent of repeating structural units having the formula



wherein each R^{29} is independently C_1-C_{18} alkyl, C_1-C_{18} alkenyl, C_1-C_{18} alkynyl, C_6-C_{18} aryl, C_7-C_{18} alkylaryl, or C_7-C_{18} aralkyl, wherein each of the foregoing groups may, optionally, be substituted with one or more substituents including epoxy, hydroxy, amino, carboxyl, and the like.

- [c17] 17.The composition of Claim 16, wherein each R^{29} is independently C_1-C_{18} alkyl.
- [c18] 18.The composition of Claim 15, wherein the poly(vinyl ester) comprises a poly(vinyl acetate).
- [c19] 19.The curable composition of Claim 1, wherein the polymeric additive is a copolymer comprising at least about 80 weight percent of the polymerization product of at least a first monomer type and a second monomer type, wherein

the first monomer type and the second monomer type are different and independently selected from the group consisting of alkenyl hydrocarbons, alkyl (meth)acrylates, vinyl alkanoates, and nitriles.

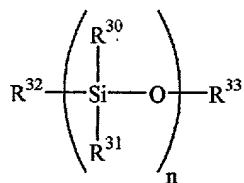
[c20] 20.The curable composition of Claim 1, wherein the polymeric additive is a copolymer selected from the group consisting of poly(butadiene- *co* -acrylonitrile), carboxy-terminated poly(butadiene- *co* -acrylonitrile), and combinations comprising at least one of the foregoing copolymers.

[c21] 21.The curable composition of Claim 1, wherein the polymeric additive comprises a butadiene-acrylonitrile copolymer, a polychloroprene butadiene-styrene copolymer, or a combination thereof.

[c22] 22.The curable composition of Claim 1, wherein the polymeric additive is a copolymer selected from the group consisting of ethylene-vinyl acetate copolymers, ethylene-ethyl acrylate copolymers, acrylonitrile-butadiene copolymers, methyl methacrylate-butadiene-styrene terpolymers, ethylacrylate-acrylonitrile copolymers, maleic anhydride-grafted polybutadienes, vinyl chloride-vinyl acetate-acrylic acid terpolymers, ethylene-vinyl acetate-acrylic acid terpolymers, and combinations comprising at least one of the foregoing copolymers.

[c23] 23.The curable composition of Claim 1, wherein the polymeric additive comprises a polysiloxane.

[c24] 24.The composition of Claim 23, wherein the polysiloxane has the formula



wherein R^{30} and R^{31} are each independently hydrogen, hydroxy, C_1 - C_{12} alkyl, C_1 - C_{12} alkoxy, C_2 - C_{12} alkenyl, C_2 - C_{12} alkynyl, C_6 - C_{18} aryl, C_7 - C_{18} alkylaryl, and C_7 - C_{18} aralkyl, wherein each of the foregoing groups may, optionally, be substituted with one or more substituents selected from the group consisting of epoxy, hydroxy, cyano, amido, amino, and carboxyl; and *n* is about 3 to about 10,000.

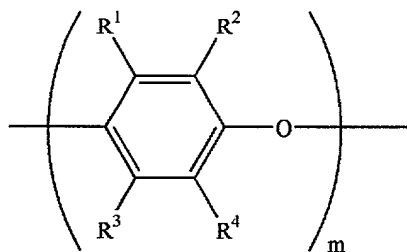
[c25] 25. The composition of Claim 24, wherein R^{30} – R^{37} are each independently C_1 – C_{12} alkyl or C_2 – C_{12} alkenyl.

[c26] 26. The composition of Claim 23, wherein the polysiloxane is selected from the group consisting of methyl silicones with phenyl and vinyl groups, and combinations comprising at least one of the foregoing polysiloxanes.

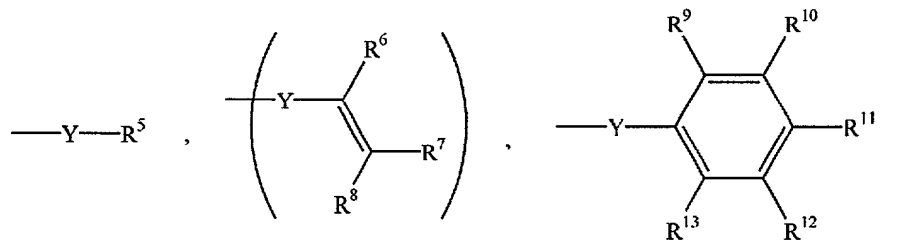
[c27] 27. The curable composition of Claim 1, comprising about 0.1 to about 30 parts by weight of the polymeric additive, based on 100 parts by weight total of the functionalized poly(arylene ether), the alkenyl aromatic monomer, the acryloyl monomer, and the polymeric additive.

[c28] 28. The composition of Claim 1, wherein the functionalized poly(arylene ether) is a capped poly(arylene ether) having the structure $Q(J-K)_y$

wherein Q is the residuum of a monohydric, dihydric, or polyhydric phenol; y is 1 to 100; J comprises repeating structural units having the formula



wherein R^1 – R^4 are each independently selected from the group consisting of hydrogen, halogen, primary or secondary C_1 – C_{12} alkyl, C_2 – C_{12} alkenyl, C_2 – C_{12} alkynyl, C_1 – C_{12} aminoalkyl, C_1 – C_{12} hydroxyalkyl, phenyl, C_1 – C_{12} haloalkyl, C_1 – C_{12} hydrocarboxy, and C_2 – C_{12} halohydrocarboxy wherein at least two carbon atoms separate the halogen and oxygen atoms; m is 1 to about 200; and K is a capping group selected from the group consisting of

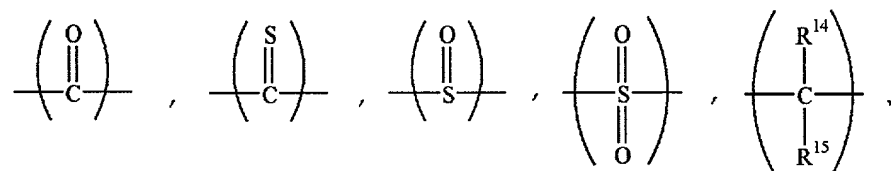


wherein R^5 is C_1 – C_{12} alkyl; R^6 – R^8 are each independently selected from the group consisting of hydrogen, C_1 – C_{12} alkyl, C_2 – C_{12} alkenyl, C_6 – C_{18}

aryl, C₇-C₁₈ alkyl-substituted aryl, C₇-C₁₈ aryl-substituted alkyl, C₂-C₁₂ alkoxy carbonyl, C₇-C₁₈ aryloxy carbonyl, C₈-C₁₈ alkyl-substituted aryloxy carbonyl, C₈-C₁₈ aryl-substituted alkoxy carbonyl, nitrile, formyl,

carboxylate, imidate, and thiocarboxylate; R⁹-R¹³ are each independently selected from the group consisting of hydrogen, halogen, C₁-C₁₂ alkyl,

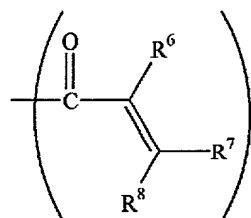
hydroxy, and amino; and wherein Y is a divalent group selected from the group consisting of



wherein R¹⁴ and R¹⁵ are each independently selected from the group consisting of hydrogen and C₁-C₁₂ alkyl.

[c29] 29.The composition of Claim 28, wherein Q is the residuum of a monohydric phenol.

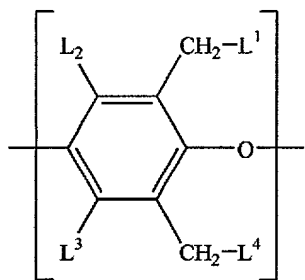
[c30] 30.The composition of Claim 28, wherein the capped poly(arylene ether) comprises at least one capping group having the structure



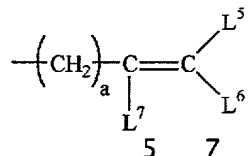
wherein R⁶-R⁸ are each independently selected from the group consisting of hydrogen, C₁-C₁₂ alkyl, C₂-C₁₂ alkenyl, C₆-C₁₈ aryl, C₇-C₁₈ alkyl-substituted aryl, C₇-C₁₈ aryl-substituted alkyl, C₂-C₁₂ alkoxy carbonyl, C₇-C₁₈ aryloxy carbonyl, C₈-C₁₈ alkyl-substituted aryloxy carbonyl, C₈-C₁₈ aryl-substituted alkoxy carbonyl, nitrile, formyl, carboxylate, imidate, and thiocarboxylate.

[c31]

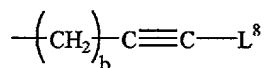
31.The composition of Claim 1, wherein the functionalized poly(arylene ether) is a ring-functionalized poly(arylene ether) comprising repeating structural units having the formula



wherein each L^1-L^4 is independently hydrogen, an alkenyl group, or an alkynyl group; wherein the alkenyl group is represented by



wherein L^5-L^7 are independently hydrogen or methyl, and a is an integer from 1 to 4; wherein the alkynyl group is represented by



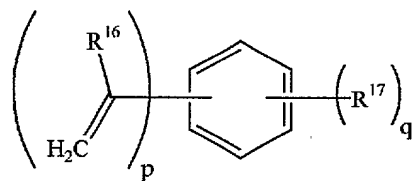
wherein L^8 is hydrogen, methyl, or ethyl, and b is an integer from 1 to 4; and wherein about 0.02 mole percent to about 25 mole percent of the total L^1-L^4 substituents in the ring-functionalized poly(arylene ether) are alkenyl and/or alkynyl groups.

[c32]

32.The composition of Claim 1, comprising about 10 to about 90 parts by weight of the functionalized poly(arylene ether) per 100 parts by weight total of the functionalized poly(arylene ether), the alkenyl aromatic monomer, the acryloyl monomer, and the polymeric additive.

[c33]

33.The composition of Claim 1, wherein the alkenyl aromatic monomer has the structure

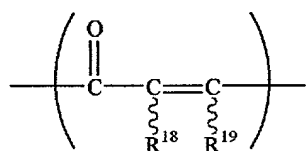


wherein each R^{16} is independently selected from the group consisting of hydrogen, C_1-C_{12} alkyl, C_2-C_{12} alkenyl, C_2-C_{12} alkynyl, and C_6-C_{18} aryl; each R^{17} is independently selected from the group consisting of halogen, C_1-C_{12} alkyl, C_1-C_{12} alkoxy, and C_6-C_{18} aryl; p is 1 to 4; and q is 0 to 5.

[c34] 34.The composition of Claim 1, wherein the alkenyl aromatic monomer comprises at least one alkenyl aromatic monomer selected from the group consisting of styrene, alpha-methylstyrene, 2-methylstyrene, 3-methylstyrene, 4-methylstyrene, 2-t-butylstyrene, 3-t-butylstyrene, 4-t-butylstyrene, 1,3-divinylbenzene, 1,4-divinylbenzene, 1,3-diisopropenylbenzene, 1,4-diisopropenylbenzene, styrenes having from 1 to 5 halogen substituents on the aromatic ring, and mixtures comprising at least one of the foregoing alkenyl aromatic monomers.

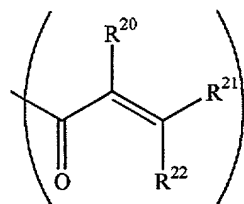
[c35] 35.The composition of Claim 1, comprising about 10 to about 90 parts by weight of the alkenyl aromatic monomer per 100 parts by weight total of the functionalized poly(arylene ether), the alkenyl aromatic monomer, the acryloyl monomer, and the polymeric additive.

[c36] 36.The composition of Claim 1, wherein the acryloyl monomer comprises at least one acryloyl moiety having the structure



wherein R^{18} and R^{19} are each independently selected from the group consisting of hydrogen and C_1-C_{12} alkyl, and wherein R^{18} and R^{19} may be disposed either *cis* or *trans* about the carbon-carbon double bond.

[c37] 37.The composition of Claim 1, wherein the acryloyl monomer comprises at least one acryloyl moiety having the structure



wherein $R^{20}-R^{22}$ are each independently selected from the group consisting of hydrogen, C_1-C_{12} alkyl, C_2-C_{12} alkenyl, C_6-C_{18} aryl, C_7-C_{18} alkyl-substituted aryl, C_7-C_{18} aryl-substituted alkyl, C_2-C_{12} alkoxy carbonyl, C_7-C_{18} aryloxy carbonyl, C_8-C_{18} alkyl-substituted aryloxy carbonyl, C_8-C_{18} aryl-substituted alkoxy carbonyl, nitrile, formyl, carboxylate, imidate, and thiocarboxylate.

[c38] 38.The composition of Claim 37, wherein the acryloyl monomer comprises at least two acryloyl moieties.

[c39] 39.The composition of Claim 1, wherein the acryloyl monomer comprises at least one acryloyl monomer selected from the group consisting of trimethylolpropane tri(meth)acrylate, 1,6-hexanediol di(meth)acrylate, ethylene glycol di(meth)acrylate, propylene glycol di(meth)acrylate, cyclohexanedimethanol di(meth)acrylate, butanediol di(meth)acrylate, diethylene glycol di(meth)acrylate, triethylene glycol di(meth)acrylate, isobornyl (meth)acrylate, methyl (meth)acrylate, and mixtures comprising at least one of the foregoing acryloyl monomers.

[c40] 40.The composition of Claim 1, comprising about 1 to about 50 parts by weight of the acryloyl monomer per 100 parts by weight total of the functionalized poly (arylene ether), the alkenyl aromatic monomer, the acryloyl monomer, and the polymeric additive.

[c41] 41.The composition of Claim 1, further comprising a curing catalyst.

[c42] 42.The composition of Claim 41, wherein the curing catalyst comprises at least one curing catalyst selected from the group consisting of benzoyl peroxide, dicumyl peroxide, methyl ethyl ketone peroxide, lauryl peroxide, cyclohexanone peroxide, t-butyl hydroperoxide, t-butyl benzene hydroperoxide, t-butyl peroctoate, 2,5-dimethylhexane-2,5-dihydroperoxide, 2,5-dimethyl-2,5-di(t-butylperoxy)-hex-3-yne, di-t-butylperoxide, t-butylcumyl peroxide, alpha,alpha'-bis(t-butylperoxy-m-isopropyl)benzene, 2,5-dimethyl-2,5-di(t-butylperoxy)hexane, dicumylperoxide, di(t-butylperoxy isophthalate, t-butylperoxybenzoate, 2,2-bis(t-butylperoxy)butane, 2,2-bis(t-butylperoxy)octane, 2,5-dimethyl-2,5-di(benzoylperoxy)hexane, di(trimethylsilyl)peroxide, trimethylsilylphenyltriphenylsilyl peroxide, 2,3-dimethyl-2,3-diphenylbutane, 2,3-trimethylsilyloxy-2,3-diphenylbutane, and mixtures comprising at least one of the foregoing curing catalysts.

[c43] 43.The composition of Claim 1, further comprising a particulate filler.

[c44] 44.The composition of Claim 43, wherein the particulate filler is calcium

carbonate.

- [c45] 45.The composition of Claim 43, comprising about 5 to about 80 weight percent of the particulate filler, based on the total weight of the composition.
- [c46] 46.The composition of Claim 1, further comprising a fibrous filler.
- [c47] 47.The composition of Claim 46, wherein the fibrous filler is glass fibers.
- [c48] 48.The composition of Claim 46, comprising about 2 to about 80 weight percent of the fibrous filler, based on the total weight of the composition.
- [c49] 49.The composition of Claim 1, further comprising an additive selected from the group consisting of flame retardants, mold release agents and other lubricants, antioxidants, thermal stabilizers, ultraviolet stabilizers, pigments, dyes, colorants, anti-static agents, conductive agents, curing promoters, and combinations comprising at least one of the foregoing additives.
- [c50] 50.The composition of Claim 1, wherein the composition after molding exhibits a shrinkage at least 10% less than the shrinkage exhibited by a corresponding composition without the polymeric additive.
- [c51] 51.The composition of Claim 1, wherein the composition after molding in a Class A surface mold exhibits an orange peel value less than 40.
- [c52] 52.The composition of Claim 1, wherein the composition after molding in a Class A surface mold exhibits an orange peel value less than 300.
- [c53] 53.A curable composition, comprising:
about 10 to about 90 parts by weight of a functionalized poly(arylene ether);
about 10 to about 90 parts by weight of an alkenyl aromatic monomer;
about 1 to about 50 parts by weight of an acryloyl monomer; and
about 0.1 to about 30 parts by weight of a polymeric additive having a glass transition temperature less than or equal to 100 ° C and a Young's modulus less than or equal to 1000 megapascals at 25 ° C;
wherein the polymeric additive is soluble in the combined functionalized poly(arylene ether), alkenyl aromatic monomer, and acryloyl monomer at a

temperature less than or equal to 50 ° C; and
wherein all parts by weight are based on 100 parts by weight total of the
functionalized poly(arylene ether), the alkenyl aromatic monomer, the acryloyl
monomer, and the polymeric additive.

[c54] 54.A curable composition, comprising:
about 20 to about 60 parts by weight of a methacrylate-capped poly(arylene
ether);
about 20 to about 60 parts by weight of styrene;
about 5 to about 20 parts by weight of an acryloyl monomer; and
about 5 to about 20 parts by weight of a polymeric additive having a glass
transition temperature less than or equal to 25 ° C and a Young's modulus less
than or equal to 100 megapascals at 25 ° C;
wherein the polymeric additive is soluble in the combined functionalized poly
(arylene ether), alkenyl aromatic monomer, and acryloyl monomer at a
temperature less than or equal to 30 ° C; and
wherein all parts by weight are based on 100 parts by weight total of the
functionalized poly(arylene ether), the alkenyl aromatic monomer, the acryloyl
monomer, and the polymeric additive.

[c55] 55.A composition comprising the reaction products of:
a functionalized poly(arylene ether);
an alkenyl aromatic monomer;
an acryloyl monomer; and
a polymeric additive having a glass transition temperature less than or equal to
100 ° C and a Young's modulus less than or equal to 1000 megapascals at 25 °
C;
wherein the polymeric additive is soluble in the combined functionalized poly
(arylene ether), alkenyl aromatic monomer, and acryloyl monomer at a
temperature less than or equal to 50 ° C.

[c56] 56.An article comprising the composition of Claim 55.

[c57] 57.An article comprising the composition of Claim 55 and selected from the
group consisting of acid bath containers, neutralization tanks, electrorefining

tanks, water softener tanks, fuel tanks, filament-wound tanks, filament-wound tank linings, electrolytic cells, exhaust stacks, scrubbers, automotive exterior panels, automotive floor pans, automotive air scoops, truck bed liners, drive shafts, drive shaft couplings, tractor parts, transverse leaf springs, crankcase heaters, heat shields, railroad tank cars, hopper car covers, boat hulls, submarine hulls, boat decks, marine terminal fenders, aircraft components, propeller blades, missile components, rocket motor cases, wing sections, sucker rods, fuselage sections, wing skins, wing flairings, engine nacelles, cargo doors, aircraft stretch block and hammer forms, bridge beams, bridge deckings, stair cases, railings, walkways, pipes, ducts, fan housings, tiles, building panels, scrubbing towers, flooring, expansion joints for bridges, injectable mortars for patch and repair of cracks in structural concrete, grouting for tile, machinery rails, metal dowels, bolts, posts, electrical encapsulants, electrical panels, printed circuit boards, electrical components, wire windings, seals for electromechanical devices, battery cases, resistors, fuses, thermal cut-off devices, coatings for printed wiring boards, capacitors, transformers, electrically conductive components for antistatic applications, tennis racquets, golf club shafts, fishing rods, skis, ski poles, bicycle parts, swimming pools, swimming pool slides, hot tubs, saunas, mixers, business machine housings, trays, dishwasher parts, refrigerator parts, furniture, garage doors, gratings, protective body gear, luggage, optical waveguides, radomes, satellite dishes, signs, solar energy panels, telephone switchgear housings, transformer covers, insulation for rotating machines, commutators, core insulation, dry toner resins, bonding jigs, inspection fixtures, industrial metal forming dies, and vacuum molding tools.

[c58] 58. An automotive part comprising the composition of Claim 55.